PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1838. No. 13.

Monday, 15th January 1838.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Donations were presented :—

Natuur-en Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenckebach. 1837. St. 1, 2.—*By the Editors.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van der Hoeven, M.D., en W. H. De Vriese, M.D. Vol. iii. Part 4.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences (1837, 2^{me} Semestre). Nos. 25, 26.—*By the Academy.*

Account of a Case of Hermaphrodism. By P. D. Handyside, M.D. —*By the Author.*

Account of a remarkable Case of Suicide, with Observations on the fatal issue of the rapid introduction of Air in large quantity into the Circulation during Surgical Operations. By P. D. Handyside, M.D., F.R.S.E.—*By the Author.*

The following Communications were read :— Rale

1. Notice regarding the Composition of Dr James's Fever Powder. By Dr Douglas Maclagan, F. R. C. S. E.

James's Powder is a patent nostrum, which has been in use for upwards of a century as a febrifuge. It was avowed by its inventor to contain antimony; but, as its mode of preparation was kept secret, the exact state in which the antimony existed in the powder was not known. The composition of James's Powder was first examined by Dr George Pearson, who published his experiments in the eighty-first volume of the Philosophical Transactions. He believed it to consist of 43 per cent. of phosphate of lime, and 57 of peroxide of antimony. M. Chenevix, in the Phil. Trans. for 1801, gave an account of some experiments which he had made on James's Powder, by which he found it to contain only 44 per cent. of the oxide of antimony. Berzelius, in his *Lehrbuch*, gives an account of an examination which he had made of a specimen of the powder. He found that about two per cent. was soluble in water, and this he found to consist of antimonite of lime. The remainder he found to contain about two-thirds of the antimonious acid, which is identical with the oxide of Dr Pearson, and one-third of phosphate of lime. The London College of Physicians had, in accordance with the views of Dr Pearson, introduced into their Pharmacopœia an imitation of James's Powder, under the title of Pulvis Antimonialis, which is now adopted by the other British pharmacopœias. This is prepared by roasting together hartshorn shavings and black sulphuret of antimony, and the product is a mixture of antimonious acid and phosphate of lime, as was shewn by Mr Richard Phillips in a paper which he published in the twentieth volume of the Annals of Philosophy. Both these preparations are much employed by physicians, but their operation has been frequently found to be very uncertain, and by many they are regarded as quite inert. This latter opinion, which is not in accordance with general experience, seems to be supported by the above view of their composition, for the antimonious acid is insoluble, even in strong acids, and the phosphate of lime is well known to be positively inert. This, however, afforded no explanation of the fact, that these powders both occasionally produce very decided effects; and, in order to discover the reason of this uncertainty of action, the author was induced to make an examination of some specimens of James's Powder and Pulvis Antimonialis. By treating them with boiling water, it appeared that both these powders contained a proportion soluble in water, which consisted of antimonite of lime and a little soluble superphosphate. The residue was acted on by hot muriatic acid, and was found to contain antimonious acid and phosphate of lime in variable proportion. By the action of sulphuretted hydrogen on the muriatic solution, it was shewn that there was always present a small quantity of sesqui-oxide of antimony, which is an active substance. The phosphate of lime was the most constant of these ingredients, generally averaging from 50 to 54 per cent. The sesqui-oxide of antimony was the most variable of all, there being sometimes as much as nine per cent., but in general, not more than three or four. The same results were obtained from Pulvis Antimonialis, the proportion of sesqui-oxide being generally smaller than in true James's Powder. As it is well known that sesqui-oxide of antimony, at a red heat, is converted into antimonious acid, it seems difficult to account for its presence in these preparations, except on the supposition, that a portion of it is united with the phosphate of lime as a triple salt, and thus escapes the action of the fire. Several specimens were examined of James's Powder, prepared by Messrs Butler and by Messrs Newberry of London, both of whom profess to follow the original recipe of Dr James, and all shewed the same variability of constitution. The same was found in various samples of Pulvis Antimonialis obtained from different druggists in Edinburgh. From these experiments it appeared, that the uncertainty of the action of these powders was probably owing to the variable proportion of sesqui-oxide of antimony which they contained, and there seemed to be nothing in the composition of the true James's Powder to warrant the high price at which it is sold.

2. Observations on the *Cysticercus Cellulosæ* inhabiting the Human Muscles. By Dr Knox.

The author commenced his memoir by observing, that about two years ago, he read to the Society some observations respecting an entozoon, of a very singular nature, occurring amongst the human muscles, a species of minute, and indeed microscopic, vibrio. The merit of the discovery was due to Messrs Hilton and Paget of London. Dr Farre afterwards gave an account of its internal structure. Soon afterwards it was announced, that this peculiar entozoon had occurred in other dissecting rooms—in Bristol, for example, and in Dublin. It was added, that the occurrence was rather frequent, in Dublin particularly, and that its existence amongst the human muscles seemed traceable to previous debility and exhaustion of the person before death had occurred. The author of the present memoir is, however, of opinion, that neither of these points has been made out clearly.

The worm, the *Cysticercus Cellulosæ,* which forms the subject of the present memoir, is oftener met with than the preceding one :

still, in Scotland it is rare. It occurs rarely in Vienna, on the authority of Bremser; but Rudolphi says, that every session a few cases occur in the dissecting-rooms of Berlin. The points of its anatomy, to which the author chiefly directed his attention, was, 1*st*, The structure of the enclosing cyst or capsule, which he still maintains to be an essential part of the worm, although not mechanically connected with it; and offers it as his decided opinion, that neither in the cysticercus, nor in the vibrio, does the enveloping cyst seem to be formed out of the surrounding cellular tissue. 2*d*, The anatomy of the disk of hooks, whose sole use anatomists have hitherto supposed to be to enable the parasite to attach itself to the surrounding textures of the animal on which, and by which it lives:—to the so-assigned use he finds an insurmountable objection if it really be, as most imagine, that the cyst or capsule is closed on all sides; and he further has described certain rounded or oval bodies, resembling globules, situated near the base of each hook, which he conjectures may be young cysticerci, which view, should it prove ultimately correct, would shew that the disk of hooks is more particularly connected with the generative system than with the digestive organs.

3. Examination of certain Objections to the Theory of Isomorphism. By Henry Madden, Esq.

The object of this paper was the refutation of certain arguments brought forward against the doctrine of Isomorphism, more especially by those who allow the existence of an approach to, although they deny absolute identity of, form.

The author sets out by shewing, that most of the arguments are deduced from observations made on crystallized minerals; and he then proceeds to state the many important circumstances which tend to influence the form of these bodies, but which can be easily avoided in those salts which admit of being formed artificially; such are, the intense temperature to which they are subjected, the pressure of surrounding matter, the admixture of foreign bodies, &c. each and all of which he proves to exert a powerful influence over the forms of crystals. From these facts, he concludes that the law of Isomorphism cannot be considered as invalidated by any slight differences found to exist in minerals, unless it could be proved that the crystals in question were formed under precisely similar circumstances. The author next proceeds to give an account of the results of his own experiments (when competing for the Hope prize), in so far as they show what circumstances require particular attention, in comparing even artificial crystals. In this part he proves, that the sooner crystals are measured after their deposition the better; that the solutions should be placed under precisely similar circumstances; that even the position of the crystals in the vessel in which they are formed, and the length of time that they have remained in contact with the mother-liquid, are circumstances of great importance, since even the system of crystallization may be changed by the latter. The author concludes by the consideration of two objections, drawn from observations made on artificial salts. The first of these is the well-known objection by Dr Clark of Aberdeen. This he refutes on the ground that the case in question is not a strict case of isomorphism, as the term is employed by Mitscherlich; and he brings forward abundant proof in support of this fact. The last objection is that which refers to the isomorphism of potass and ammonia; here, however, he shews that the difficulty falls to the ground, if the new and evidently more correct notion regarding the constitution of ammoniacal salts be substituted for the older opinion.

Monday, 5th February.

Sir GEORGE MACKENZIE, Bart., in the Chair.

The following Donations were presented.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, (1837, 2^{me} Semestre), No. 26, et (1838, 1er Semestre), Nos. 1, 2.—*By the Academy.*

Bulletin de la Société de Géographie, 2^{me} Serie, Tome vii.—*By the Society.*

Bulletin de la Société Géologique de France. Tome viii. Feuilles 21-25.—*By the Society.*

Journal of the Asiatic Society of Bengal for June 1837.—*By the Society.*

The following Communications were read.

1. Observations on the Parr and Young of the Salmon. By Dr Parnell.

2. Notice of the remarkable Mathematical Properties of a certain Parallelogram. By John Scott Russell, M. A., F. R. S. E.

The parallelogram which formed the subject of this communication is the rectangle whose sides are to each other in the ratio of the diagonal of a square to its side,—a figure well known to architects, sculptors, and painters, from its beauty, and frequently adopted in the practical arts.

The author shewed that if the given rectangle be bisected by a line parallel to its shortest side, each segment will be a figure similar in all respects to the original rectangle; and if either of these halves be itself bisected in the same manner, their halves will be rectangles similar to the original rectangle; and so on *ad infinitum*. The sides of the primary figure and its halves are continual proportionals, represented by the series

$$b, \frac{1}{\sqrt{2}}b, \frac{1}{\sqrt{2^2}}b, \frac{1}{\sqrt{2^3}}b, \frac{1}{\sqrt{2^4}}b \ldots\ldots \frac{1}{\sqrt{2^{n+1}}}.b.$$

The author endeavours to trace an analogy between the properties of this parallelogram and the logarithmic spiral.

A class of figures may be obtained by trisection and by division into four, five, or any number of figures, all of them similar to the primary figure, and capable of division *ad infinitum* in the same manner.

Monday, 19*th February*.

DR HOPE, V. P., in the Chair.

The following Donations were presented:

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, (1838, 1er Semestre), Nos. 3, 4, 5.—*By the Academy.*

Bulletin des Séances de l'Académie Royale de Bruxelles, (1837). Nos. 1, 2, 3, 4, 5, 6, 7, 8.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome x.

Memoires Couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xi.—*By the Academy.*

Annales de l'Observatoire de Bruxelles, publiés, aux frais de l'etat, par le Directeur A. Quetelet. Tome i. partie 2.—*By the Author.*

Mémoires sur Trois Intégrales Définies, par M. J. Plana, Directeur de l'Observatoire de Turin.—*By the Author.*

Transactions of the Cambridge Philosophical Society. Vol. 6, Part ii.—*By the Society.*

Bulletin de la Société de Géographie. 2^{m}_{e} Serie, Tome 8.—*By the Society.*

The following Communications were read:

1. On the Composition of a new Ink, which, by resisting chemical deletion, promises to diminish the chances of the successful falsification of bills, deeds, and other documents. By Professor Traill.

The author was led to the investigation of this subject by its connection with that branch of Medical Jurisprudence which treats of the prevention and detection of forgery.

It is well known that common writing-ink may be totally effaced from paper by certain chemical agents, and that several others so impair its colour, that the characters traced with it become illegible. To the first class of chemical agents belong chlorine, and substances containing it, as well as oxalic acid: to the second diluted solutions, or the vapours of the mineral acids, and of the caustic alkalis. These agents were applied to written specimens of a great number of different inks, and the degree of resistance to their effects was considered as the criterion of the durability of each.

These views engaged the author in an extensive series of experiments on coloured metallic preparations, suspended in different vehicles, the results of which were laid before the Society. In one series, the colouring matter was precipitated on paper previously imbued with various chemical substances, capable of effecting the decomposition of the solutions applied; but no advantage was derived from this method. No useful results were obtained from the use of any of the metallic sulphurets or iodides, either alone or mixed with common ink; nor from preparations of indigo or other vegetable colours. Among the metallic preparations which resisted chlorine was a fine blue substance obtained by precipitating chloride of antimony by ferro-cyanide of potassium: but it was immediately destroyed by ammonia. The rich yellow substance formed by adding nitrate of cobalt to ferro-cyanide of potassium resists alkalis well; but it is effaced by acids. An ink composed of both these last-mentioned metallic salts was effaced by immersion, first in chlorine, and then in an alkali.

These failures to produce a durable ink from metallic combinations induced the author to attempt the composition of a carbonaceous liquid which should possess the qualities of good writing-ink

The inks used by the ancients were carbonaceous, and have admirably resisted the effects of time; but the author found that the specimens of writing on the Herculaneum and Egyptian *papyri* were effaced by washing with water; and on forming inks after the descriptions of Vitruvius, Dioscorides, and Pliny, he found that they did not flow freely from the pen, and did not resist water,—qualities essential to a good writing-ink in modern practice.

The carbonaceous inks with resinous vehicles, rendered fluid by essential oils, though they resisted water and chemical agents, had the disadvantages of not flowing freely from the pen, and of spreading on the paper, so as to produce unseemly lines. Solutions of caoutchouc in coal-naphtha, and in a fragrant essential oil, lately imported from South America, under the name of *aceite de sassafras* (the natural produce of a supposed Laurus), were subject to the same objections.

The author tried various animal and vegetable fluids as vehicles of the carbon, without obtaining the desired result, until he found, in A SOLUTION OF THE GLUTEN OF WHEAT IN PYROLIGNEOUS ACID, a fluid capable of readily uniting with carbon into an ink, possessing the qualities of a good, durable, writing ink. To prepare this ink, he directs gluten of wheat to be separated from the starch as completely as possible, by the usual process, and when recent to be dissolved in pyroligneous acid with the aid of heat. This forms a saponaceous fluid, which is to be tempered with water until the acid has the usual strength of vinegar. He grinds each ounce of this fluid with from eight to ten grains of the best lamp-black, and one and a half grain of indigo. The following are the qualities of this ink.

1. It is formed of cheap materials.
2. It is easily made, the colouring matter readily incorporating with the vehicle.
3. Its colour is good.
4. It flows freely from the pen.
5. It dries quickly.
6. When dry it is not removable by friction.
7. It is not affected by soaking in water.
8. Slips of paper written on by this ink have remained immersed in solutions of the above-mentioned chemical agents, capable of immediately effacing or impairing common ink, for seventy-two hours, without change, unless the solutions be so concentrated as to injure the texture of the paper.

The author offers this composition as a writing-ink, to be used on paper, for the drawing out of bills, deeds, wills, or wherever it is important to prevent the alteration of sums or signatures, as well as for handing down to posterity public records, in a less perishable material than common ink. He concluded his paper by stating, that should it be found to present an obstacle to the commission of crime—should it, even in a single instance, prevent the perpetration of an offence so injurious to society as the falsification of a public or a private document, the author will rejoice in the publication of his discovery, and consider that his labour has not been in vain.

2. Abstract of first part of Memoir on the Mid-Lothian and East Lothian Coal Districts. By David Milne, Esq.

The author commenced his communication by stating, that he should divide his memoir into two parts, the first being devoted to a mere narrative of *facts*, the second to *explanations* of these facts.

In describing the geological features of the district, he noticed first the *stratified* or rudimentary rocks, and next the *unstratified* rocks.

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The STRATIFIED consist of sandstone, shales, limestones, coal, and clays; which rocks seemed severally to abound or prevail, in the order now stated.

These stratified rocks overspread the district from Portobello to Gladsmuir, in an east and west direction; and from the Firth of Forth to the Lammermoor Hills, in a north and south direction. Within these limits there are two basins,—the basin of the Esks, and the basin of the Tyne; and which basins are divided by the ridge or high ground that runs from Prestonpans (on the shore of the Firth) by Tranent, Falside, Carberry, and the Roman Camp.

The Esk basin contains between sixty and seventy coal-seams, exceeding one foot in thickness. The Tyne basin contains not more than ten or twelve, being those which appertain to the lower part of the deposit. The vertical depth of the Esk basin in its trough,—or, in other words, the thickness of the deposits composing it, is between 1000 and 1050 fathoms; but this thickness diminishes rapidly to the south, arising chiefly from the coal-seams and sandstone strata thinning away in that direction; and which diminution is compensated in but a trifling degree, by the increased thickness of the limestone in the same direction.

The Tyne basin comprehends only the deposits lying below the Great Seam of coal, and the entire thickness of these, is greatly less than in the Esk basin, arising chiefly from the sandstones and coals thinning away towards the east.

The strata on the west side of the *Esk* basin, dip to the east and south-east at a very steep angle, and are in some places absolutely vertical. On the opposite or east side of the Esk basin, they slope to the west at an angle varying from 20° to 40°.

The strata on the west side of the *Tyne* basin dip to the east, at an angle varying from 15° to 20° ; and on the opposite or east side of the same basin, they dip to the west at an angle of only 5° or 6°.

In the intervening ridge which runs from Prestonpans to the Roman Camp, the strata mantle over from the one basin into the other, and are there occasionally broken so as to shew an anticlinal line.

The different kinds of coal were described ; and it was stated, that each kind was characterized by differences in the fissures or joints intersecting them.

The principal slips in the district were next pointed out ; and the author referred to a table he had constructed, shewing the direction of each, and the amount of dislocation produced on the intersected strata. Between eighty and ninety of these were also laid down on the map accompanying the memoir.

In describing the UNSTRATIFIED rocks of the district, the author mentioned, there were no hills or amorphous masses of trap within the proper limits of the Lothian coal-field ; and that the trap shewed itself only in dykes, which run in straight lines intersecting the strata. He pointed out three or four such dykes, varying from 60 to 120 feet in width,—all of which appeared gradually to thicken towards the west, and all of which run in nearly an east and west direction.

3. The following Memorandum was communicated by Professor Forbes.

" A series of delicate and tedious experiments on heat have conducted me to the following results, which will be fully discussed in a paper shortly to be laid before the Society.

" 1. An entire confirmation of my previous statement, that different kinds of heat are differently susceptible of polarization by transmission through a given bundle of mica plates ; heat from obscure sources being less polarizable than that from luminous sources. I considered my investigations incomplete until I had proved not only that my former experiments had led me to correct results, but also why the only other person who I believe has attempted to obtain them was led to the opposite conclusion, as stated by M. Melloni in the Annales de Chimie for May 1837, namely, that all kinds of heat are *equally* susceptible of polarization. I have at length discovered, in the description of M. Melloni's method, the cause of his failure to detect this fact.

" 2. I have ascertained the laws and measures of the depolarization of heat by the doubly refractive energy of mica plates, by three series of experiments with heat from different sources, each performed with mica of various thicknesses.

" 3. I have discovered a method of measuring the mean index of refraction of heat from different sources with very considerable numerical exactness, which it is believed is now done for the first time; and the results confirm the opinion already entertained, that dark heat is the least refrangible, whilst that portion of luminous heat which is transmitted by glass is the most refrangible. The principle of the method includes a complete analysis of the heterogeneous heat derived from any source into any number of portions, between assigned limits of refrangibility."

Monday, 5th March.

SIR T. M. BRISBANE, Bart. P. in the Chair.

The following Honorary Fellows were elected:

Prof. Tiedemann, Heidelberg.
Prof. Müller, Göttingen.

The following Donations were presented:

Elements of Chemistry, by the late Edward Turner, M. D., sixth edition, enlarged and revised by Professor Liebig and Wilton G. Turner. Part 11.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. No. 6, 1er Semestre 1838.—*By the Academy.*

Flora Batava. Nos. 112 and 113.—*By the King of Holland.*

On the Nature and Treatment of the Diseases of the Heart; with some views on the Physiology of the Circulation. By James Wardrop, M. D., Surgeon to his late Majesty Geo. IV., &c. &c. *By the Author.*

Notice sur les Marbres; par M. Theodore Virlet.—*By the Author.*

The Quarterly Journal of Agriculture, and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. No. 40, March 1838.—*By the Society.*

Bulletin de la Société Geologique de France. Tome ix. Feuilles 1–5.—*By the Society.*

Recherches Historiques de Statistiques sur la Population de Geneve. Par Edouard Mallet.—*By the Author.*

Researches into the Cause of Voltaic Electricity. By Mons. Auguste De la Rive.—*By the Author.*

De l'Influence qu'exerce la Chaleur sur la Facilité que le Courant Electrique possede a passer d'une liquide dans un Metal. Par M. la Professeur A. de la Rive.—*By the Author.*

Proceedings of the Royal Society. Nos. 28, 29, 30.

Address of his Royal Highness the Duke of Sussex, K. G., the President, read at the Anniversary Meeting of the Royal Society on November 30. 1837.

Address to her Majesty, referred to in the Address of his Royal Highness the President of the Royal Society.

Philosophical Transactions of the Royal Society of London, for the year 1837. Parts 1 and 2.

List of the Fellows of the Royal Society for the year 1837.

Astronomical Observations made at the Royal Observatory, Greenwich, in the year 1836, under the direction of George Biddell Airy, Esq. M. A. Astronomer-Royal.—*By the Royal Society.*

The Mathematical Journal of Cambridge. Nos. 1 and 2.—*By the Editor.*

Malacologia Monensis. A Catalogue of the Mollusca inhabiting the Isle of Man and the neighbouring sea. By Edward Forbes, President of the Royal Physical Society of Edinburgh, &c. &c.—*By the Author.*

The following Communications were made:

1. Notice regarding a New British Species of *Coregonus*. By Dr Parnell. (See Plate.)

It was stated by Dr Parnell, that in Lochlomond are found two species of Coregonus, one of which he believes to be an undescribed species, and the other, which was first noticed by Lacépède under the name of *Coregonus Clupeoide*, has been confounded by British naturalists with the *Coregonus Laveretus*, or Ulswater Gwyniard.

From Lacépède's short and imperfect description of the *Coregonus Clupeoide* of Lochlomond, and as two species are now found inhabiting the same locality, it is impossible to state with a certainty as to which of the species he alludes; therefore the name of

Coregonus Lacepedei was proposed for the one species, and that of *Coregonus microcephalus* for the other, as illustrative of the species.

The *Coregonus Lacepedei* occasionally grows to the length of sixteen inches, and is distinguished by the great length of head compared with that of the body; the snout extending beyond the upper lip; the under jaw the shortest; the length of the pectorals and dorsal fin; the large scales, the number of rays in the anal fin; the peculiar shape of the caudal, and the position of the dorsal. It agrees in figure with *Salmo Wortmanii* of Bloch, but not in description.

The *Coregonus microcephalus* does not grow to the size of the last species, and differs from it in the head and pectorals being considerably shorter, and the snout not projecting beyond the upper lip. It is at once removed from the vendace and pollan in the under jaw being the shortest. On comparing it with the Gwyniard, it is a much deeper fish, the head and pectorals much shorter; the upper jaw furnished with distinct teeth: anal fin with fewer rays; besides it grows to a larger size than the Gwyniaad.

These fish are found in Lochlomond in great numbers, where they are named Powans or Freshwater Herrings, and are much prized in that neighbourhood as being wholesome, well-flavoured and delicate food, particularly during the autumn months. In the stomachs of those examined were found several species of entomostracious animals, larva of insects, a few coleoptera, and a number of small tough red worms. They shed their spawn in the months of October and November, after which they continue out of condition till March.

2. Abstract of Part II. of Memoir descriptive and explanatory of the Mid Lothian and East Lothian Coal-fields.

This part of the memoir was devoted exclusively to an attempt to *explain* or account for the facts described in the first part of the memoir.

The geological epoch when the strata composing the coal-measures of this district were deposited, was first noticed. It was stated that these coal-measures were deposited at a period immediately following the deposition of the old red sandstone formation; and that this older formation was to be seen both on the north and on the south sides of the Lammermuir Hills, dipping under the coal-measures, and resting on the upturned greywacke strata of these hills. The lowest member of the old red sandstone group is a coarse conglomerate, evidently formed by the denudation of these greywacke hills; and the uppermost members consist of soft argillaceous sandstone, of a deep red colour.

The coal-measures of this particular district extend also over the whole of East Lothian, though towards the north and north-east, they are much broken and shattered by eruptions of trap. Beyond the east and south-east crop of the Tyne Coal Basin, there are no members of the coal-measures proper, except those which occupy the lowest part of the series. The limestone known in the Esk and the Tyne Basins, as lying under the North Greens Coal, undulates along or near the surface, throughout all the country between Haddington and the sea, towards North Berwick, as well as Dunbar and Dunglass, except at those places now occupied by trap hills.

It appears that along the east margin of the Tyne Basin there is an anticlinal line, from which the limestone just spoken of dips gently to the east, so as to form in some measure a third basin, but one very flat and much broken.

The author proceeded next to speculate on the probable mode in which the strata of the coal-measures had been severally formed. It was inferred from various circumstances, that they must have been all deposited at the bottom of an aqueous medium, which in certain parts, or at certain periods, was calm and tranquil, and which, in other parts, or at other periods, was agitated by currents.

The *shales* and *clays*, it was said, might have been formed of sediment washed down from the Lammermuir Hills; but it was thought that the siliceous sediment necessary for the enormous deposits of *sandstone* must have come, not from the greywacke hills chiefly, but from primitive formations, and which were probably situated far off towards the west and north.

In regard to the origin of the *limestone* strata in the district, it was inferred, that they had been formed by a precipitate of carbonate of lime, held in solution by the aqueous medium which overspread the district. Water, it was said, would hold carbonate of lime in solution, if there was an excess of carbonic acid; and on the application of heat, a part of the carbonic acid gas would be liberated, and a precipitate occasioned. To account for the remarkable fact, that the limestone underlying the North Greens coal thickened as it approached the Lammermuir Hills, it was suggested that the water may have been warmer near them, not only from its being shallower there, and thus more capable of being acted on by solar and atmospheric influence,—but also from the subterranean heat being there more intensely felt or more frequently evolved. The same theory might account for the formation of limestone in the upper part of the basin, though in proportion to the distance between the subterranean heat and the water, the precipitates of lime would become less abundant and less frequent; a consideration which would explain why the five or six beds of limestone that occur in the district, are all situated in the lower half of the basin.

With regard to the origin of the *coal*-seams, it was observed, there could be no doubt of their having been formed from accumulations of vegetable matter, which, at different periods, had been drifted from a distance. The fact of these accumulations having taken place at the bottom of the same sea or aqueous medium in which the other strata of the basin were successively deposited, seemed to be placed beyond dispute, by the discovery in the substance of the coal itself, and about four inches below the top of a seam of coal,—of quantities of the teeth, bones, and scales of fish. These remains belong to the same species, the remains of which had been found in the shales of this coal-field by Lord Greenock, and in the Burdiehouse limestone by Dr Hibbert.

The vegetable matter which formed most, if not all, of the coal-seams of the district, appeared to have been drifted from the west or north-west, because in these directions the seams get gradually thicker.

As all the vegetables found in the coal-seams and adjacent shales are terrestrial, it seemed probable that they had been torn off or swept away from their native sites by periodical inundations:—that they had been carried out into a great lake or estuary, where, after floating about for a considerable time, they subsided in tranquil waters, but not before parting with the clay and other earthy matters attached to their roots, and not before the sediment carried off by the inundation, and mechanically suspended in the water, had time to subside. It was inferred from this circumstance, that beneath every seam of coal there ought to be a bed of fire-clay,—an inference which agrees with the fact.

After these vegetable accumulations had taken place, and probably after all the other strata of the basin were deposited, the entire series of rocks had evidently been operated on by some powerful agent, so as to give to each its peculiar crystalline structure, and many of the other known peculiarities in their constitution. That some such agent must have operated appears to be proved, (1.) By the formation of joints and fissures intersecting the strata; (2.) By the conformity of direction in these joints and fissures; (3.) By the internal movement of the particles or ingredients of the vegetable mass among each other, whereby different kinds of coal were formed in the same seam; and (4.) By the fissures and cavities in the coal being generally filled with *pearl-spar*, which could only be derived from an aqueous medium impregnating the vegetable mass, and holding carbonate of lime and magnesia in solution. It was inferred from these and other circumstances, that the agent which had operated on the strata after their deposition, was subterranean heat.

The rest of the paper was occupied with an explanation of the convulsions which had occurred after the deposition of these strata, and in consequence of which they had been thrown into the form and position now presented by them. It was mentioned that the very steep dip to the eastward, which the strata on the west side of the Esk basin presented, was occasioned by the eruption of Arthur Seat, Blackford Hills, and the other trap masses that occur along almost the whole extent of the west side of that basin.

It was next shewn, that before the enormous quantity of volcanic matter which burst forth emerged from beneath the strata of the district, these strata must have suffered dislocations or cracks, which would account for the slips and dykes that intersect the district. It was also shewn, how these slips and dykes behoved to run generally in a direction between N. and W., and cause the dislocated strata to sink down on the north side of them, rather than on their south sides. An explanation also was offered of the invariable rule which had been found to prevail in this district as in others, that if a slip haded or sloped from the vertical, the strata were always lowest on the upper side of the slip. A reason was also assigned for the fact, that in this district, the strata are not deranged (or in other words, "thrown down" on either one side or other) by *dykes*, but only by slips.

Monday, 19*th March.*

Dr HOPE, V. P. in the Chair.

The following donations were presented:—

Annals of Natural History, or Magazine of Zoology, Botany, and Geology. Conducted by Sir William Jardine, Bart.; P. J. Selby, Esq.; Sir W. J. Hooker; and Richard Taylor, Esq. (No. 1, new series).—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. 1er Semestre 1838. Nos. 7, 8, 9.—*By the Academy.*

Proceedings of the Geological Society of London. Nos. 52, 53.

Transactions of the Geological Society of London. (Second Series.) Vol. 5, Part 1.—*By the Society.*

Theory of Heat. By Philip Kelland, M. A., Fellow and Tutor of Queen's College, Cambridge.—*By the Author.*

Hortus Mauritianus, ou Enumeration des Plantes Exotiques et Indigenes, qui croissent à l'Ile Maurice, disposées d'apres la Methode Naturelle. Par W. Bojer.—*By Lord Glenelg, H. M. Sec. of State for the Colonies.*

Journal of the Asiatic Society of Bengal, for June and August 1837.—*By the Society.*

The Keith Medal awarded by the Council to Mr John S. Russell for his Researches on Hydrodynamics, was presented by the Vice-President.

The following communications were read:—

1. Practical Researches on Respiration. By Dr D. B. Reid.

The object of the author was to lay before the Society the result of an investigation into the state of the air usually respired in public buildings in this country and on the continent, to shew that the amount of air usually allowed for respiration is far below what is necessary to sustain the system in a healthy tone, and to give an account of the various experiments and observations upon which this opinion was founded.

He entered also into an examination of the method that ought to be adopted in introducing and regulating the supply in different apartments. In pointing out some facts connected with the general history of respiration, he endeavoured to shew the powerful influence exerted by a full supply of light, and the important effect it has upon the general health ; and concluded by referring to the minute quantities in which he had found some gases to exert a very deleterious influence upon the animal economy, and a statement of the result of experiments made with absolute carbonic acid, and various mixtures of this gas with air.

2. Observations on the Fur Seal of Commerce. By Robert Hamilton, Esq.

The author states that the Fur Seal merits attention in a commercial as well as a scientific point of view. The South Sea Seal trade, though comparatively of recent origin, has been prosecuted to a much greater extent than the northern ; and especially in pursuit of two species of seals,—the *Proboscis* Seal, or Sea Elephant, for its oil, and the Fur Seal, for its skin.

After some preliminary remarks upon the nature of the coats or robes of seals, the author, in the absence of scientific information concerning the fur-seal, turns to the works of navigators and seal-hunters, and finds distinct allusion made to it in the writings of Cook, Clayton, and especially of Mr Weddell, who commanded several expeditions undertaken chiefly for its capture. This last-named gentleman, several years ago, presented two stuffed specimens of the animal to the Royal Museum of the Edinburgh University, and from these a detailed account is given of the external characters, and the measurements, together with a coloured drawing by Mr Stewart. The animal is an Otary ; the length of the largest males is little short of 7 feet, whilst that of the full-grown female is about 3½ feet. The habits of the animal, so far as known, are then supplied, together with an explanation of that singular peculiarity common to the whole group, whereby, with little or no use of their limbs, these amphibious quadrupeds can yet, on land, outstrip a man pursuing them at full speed.

The author then turns to the identification of this species, and endeavours to shew that it is not the *Ursine Seal*, or Sea-bear, as stated by some eminent French naturalists ; and, on the other hand, that the *Longicollis* and *Falklandica*, generally enumerated as belonging to different genera, and whose descriptions are universally regarded as too vague and obscure to be of any value, are yet one and the same species, and that identical with the Fur-seal. This animal is at the same time distinct from the Otary discovered in the Falkland islands by MM. Lesson and Garnet, and described as the *O. Molossina* in the "Zoologie de la Coquille."

In conclusion, the author maintains that there are probably other seals which would yield fur similar in quality to that which was long so much valued, and is now so greatly desiderated.

Monday, 2d April.

Dr HOPE, V. P., in the Chair.

The following donations were presented :—

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 8.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. 1838. 1er Semestre. No. 10.—*By the Academy.*

Madras Journal of Literature and Science. Published under the auspices of the Madras Literary Society, and Auxiliary Royal Asiatic Society. Nos. 15, 16, and 17.—*By the Society.*

The following communications were read :—

1. On the Wild Ox of Scotland. By Dr Knox.

In this memoir, the author endeavours to trace the antiquity of the white oxen of Cadzou and of Tankerville during the historic period of Britain, but thinks that materials are altogether wanting for such an inquiry. No records exist in proof of these cattle being aboriginal; or, if introduced into the island by any of the three great races of men found in it, it would be difficult to offer a conjecture by which race they were introduced. Had the cattle of Britain been generally white in Cæsar's time, it is probable that that great man would have noticed the fact. The author thinks it even probable that these white cattle may have been introduced by the Romans themselves, since they are not found in Ireland. Tacitus mentions that the German cattle were without horns in his day. By " Germans," Tacitus here means the Saxon race; and yet the descendants of these Saxons in Holland had so completely lost all trace of the polled or hornless cattle of their ancestors, that they refused credit to Camper when he asserted to his countrymen that he had seen cattle without horns in Britain.

In the second part of the memoir the author examines the question, Whether the white cattle of Britain constitute a distinct species of the Bovine tribe, *i. e.* distinct from any known species or variety of the domestic ox? and he thinks that they do not; but, as the domestic ox of Britain, and of almost all countries, are now a mixed breed, derived from several species, he is at a loss, from want of materials, to shew to which of these species the white ox of Hamilton most approaches. They seem to him to bear the strongest resemblance to the Galloway breed. From not having been able to procure a cranium of the Tankerville white ox, he, of course, cannot say to what species it may belong.

The cranium of the wild ox of Hamilton differs very much from that of most domestic oxen, particularly in the breadth of the forehead, shortness of the nasal bones, and configuration of the interior of the nostrils. Many of the bulls have horns, whilst others are polled.

The author, with reference to the relation these oxen bear to fossil crania of the Bovine tribe, thinks that none of the fossil specimens which he has seen in museums, or which have been delineated in M. Cuvier's work, could have belonged to an animal similar to the existing species, and thinks that they may have differed even generically.

The author suggests, in conclusion, that the type of these cattle can never be satisfactorily made out, so long as their breeding is so much interfered with, by the destruction of all the calves which may differ in form or colour from the standard considered by the noble proprietors as essential to the purity of the breed.

Date

2. On the Third Pair of Nerves. By Sir C. Bell.

This paper is the first of three communications, in which is shewn the distinctions in the regular series of nerves arising from the spinal marrow, and the ten nerves which arise directly from the brain.

The author remarks, that unless we comprehend the reason of the perfect symmetry of the spinal nerves, as contrasted with the irregularity of the encephalic nerves, we must confess ignorance of much of the structure of the animal frame.

After a general view of the nerves arising from the base of the brain, and assigning the reason of their apparent irregularity, he enters on the investigation of the third nerve. He shews that it arises from the distinct columns of which the *crus cerebri* is composed, by courses of parallel filaments; and that these afterwards compose a dense structure resembling ganglion. From the anatomical facts he deduces these conclusions:—That the third nerve being the motor of the eye, is unique in structure and function;

that it arises anterior to the *pons* or *nodus cerebri,* in order to be free of the intricate texture of nerves which have reference to the complex operations of the trunk and limbs; that the necessary combination of motion and sensation in the eye, uncontrolled by remote relations, and free of the combined operations of the frame, is the reason both of its peculiar origin and of the intimate combination of a sensitive and motor root.

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3. Inquiry whether Sea Water has its Maximum Density at some degrees above its freezing point, after the manner of fresh water. By Dr Hope.

Dr Hope stated that it has been considered a matter of considerable importance in the reasonings of geologists and hydrographers respecting some oceanic phenomena, whether sea water obeys at all temperatures the general law of expansion by heat, and contraction by cold, or, after the manner of fresh water, observes the anomalous course of contracting by heat, and expanding by cold, during a short range of temperature near its congealing point.

In 1788, Sir Charles Blagden concluded, from a solitary experiment, that a solution of common salt, chloride of sodium, in water, began to expand, when cooled to about 8° above its freezing point; and thence it has been inferred, that all solutions of salt will exhibit the same phenomenon; and the law has been laid down, that the combination of a salt with water has no other effect upon its quality of expanding by cold than to depress the point at which that quality begins to be sensible, just as much as it depresses the point of congelation, and that saline solutions begin to expand at 7½° above their point of congelation. Transferring these views to sea water, its maximum density was supposed to be about 36½°. Various reasonings were founded upon that supposition.

Dr Hope then adverted to the discordant experiments of Dr Marcet in 1819, of M. Erman in 1828, and of M. Despretz in 1836 and 1837.

The object of Dr H.'s inquiries was to ascertain whether sea water and stronger solutions of common salt are subject to the common law, or the anomalous aqueous one. He carried on the investigation in two modes, 1st, By employing thermometric glasses, containing the saline fluid, and observing the descent of the fluid in the stem during cooling to the point of congelation, and its subsequent ascent when again exposed to heat.

The result was, that the fluids descended in the tube from cold, and ascended from heat uninterruptedly, as mercury and alcohol do; and did not, like water, present any appearance of interruption in their course or retrocession.

2d, But as doubt must always hang over experiments conducted in this manner, in consequence of the interference of the changes in the capacity of the thermometric instruments, arising from the alterations of temperature, he resorted to the method described in his memoir read to this Society in 1804. This consists in discovering the effects of heat and cold on the density of fluids, by ascertaining by thermometers placed near the top and bottom of a column of the fluid, the direction of the currents induced in the fluids, fully assured, that the rarer will invariably ascend, and denser descend. Proceeding in this manner, Dr H. found that, when a frigorific mixture was applied to the middle of a column of sea water at the 40th degree, the cooled water immediately began to descend to the bottom, and continued to do so steadily, till the thermometer at the bottom indicated the congealing temperature of the fluid; and again, that when heat was thrown into the middle of a column of sea water cooled to its freezing point, the heated fluid immediately began to ascend, and continued to do so uniformly and uninterruptedly.

From this and the preceding series of experiments, Dr Hope considered himself warranted to conclude, that the strange anomaly which fresh water presents does not exist in sea water.—That at all temperatures above its point of congelation, it is expanded by heat and contracted by cold, and that its maximum of density does not occur at $7\frac{1}{2}°$ above its point of congelation, as is the case with pure water.

Dr Hope did not touch the very difficult and perhaps indeterminable question, viz. the temperature at which sea water and solutions of salt have their maximum of density; reserving that question, and the consideration of the effects of various substances soluble in water in rendering this fluid obedient to the general law of expansion by heat and contraction by cold, for another memoir.

Monday, 9th April.

Dr ABERCROMBIE, V. P. in the Chair.

The following donations were presented :—

Report on the Physical Condition of the Assam Tea Plant, with reference to Geological Structure, Soils, and Climate. By John M'Clelland, Esq., Assistant-Surgeon, Bengal Establishment.—*By the Author.*

Seventeenth Report of the Council of the Leeds Philosophical and Literary Society at the close of the Session 1836–7.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, 1838, 1er Semestre, Nos. 11, 12.—*By the Academy.*

Proceedings of the Geological Society of London, Nos. 54 and 55. —*By the Society.*

Nieuwe Verhandelingen der Eerste Klasse van het Konninklijk-Nederlandsche Instituut van Wetenschappen, Letterkunde en Schoone Kunsten te Amsterdam, Vol. 6.—*By the Institute.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. 1835.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königl. Preuss. Akademie der Wissenschaften zu Berlin vom Mai 1836 bis Juni 1837.—*By the Academy.*

Bestimmung der Länge des einfachen Secundenpendels fur Berlin von F. W. Bessel.—*By the Author.*

Astronomische Beobachtungen auf der Königlichen Universitäts—Sternwarte in Konigsberg von F. W. Bessel. 18th part.—*By the Author.*

The Glasgow Mortality Bill for the year ending 31st December 1837. By Henry Paul, Accountant.—*By the Author.*

Ordnance Survey of the County of Londonderry. Colonel Colby, R. E., F. R. S. L. & E. &c. Superintendent. Vol. 1.—*By the Lord Lieutenant of Ireland.*

Views of the Architecture of the Heavens, in a Series of Letters to a Lady. By J. P. Nichol, LL. D., F. R. S. E.—*By the Author.*

The following communications were read :—

1. On the Origin and Compound Functions of the Facial Nerve or Portio Dura of the Seventh Nerve. By Sir C. Bell.

In this paper the author treats of the *Facialis* nerve or portio dura of the seventh nerve.

He commences with a view of the Respiratory System of Nerves. Vindicating the term, he proceeds to shew that the *Facialis* belongs to this system, and that it possesses a double function and double origin. That this composite condition of the nerve is not, however, like the double nerves of the spine (which have a root for motion and a root for sensation), but that its origins shew it to be connected with the column of voluntary motion and of the column of respiration. He then enters on the illustration of the various influences exerted through the filaments of this small nerve on the face. Its double relation to the will and to the automatic action—the motions of the air-passages in unison with the other respiratory actions—the combination with the same in speech; and, finally, as they are the instruments of expression, of emotion or passion. Concluding with a comparison of the many functions of the nerve with its complex origins.

Date

2. Description of the Hydrodynameter, a new instrument for shewing the rate of Sailing of Ships and Velocity of Currents, Rivers, Tides, &c. By Mr R. Adie, of Liverpool. Communicated by Dr Traill.

N° 213

The author here first refers to the differential barometer of the late Dr Wollaston, from which he derives his new instrument. He then describes the instrument, which, in its simplest form, consists of a glass-tube bent into the form of the letter U inverted, the one end open in the line of the arms downwards, the other has its point turned up at right angles to this line. A divided scale is placed between the tubes, having its zero point as the centre. When the instrument is used, the upper curve and arms are to be filled with oil, or any other fluid lighter than water, as far as the zero on the scale; the remaining parts of the tubes are to be filled with water. If the instrument is in this state placed in any current, with the end of the tube which is bent at right angles turned towards the current, the oil will rise in the one arm and descend in the other, till the velocity of the current is counterbalanced by the length of the column of oil displaced, and this varying with the velocity, serves as its measure. The author then goes on to describe the form of instrument to be used for giving the rate of sailing of a ship, being a modification of the same instrument, to answer the situation and to correct for want of perpendicularity caused by the heeling of the vessel. The communication with the sea is made by tubes brought from the bottom at midships to the cabin, where the glass tubes and scale are placed; and the rate of sailing may at all times be known by observing the length of the column of oil displaced.

3. A verbal communication on the Osseous Structure of Fishes. By Dr Macdonald.

Monday 16*th April.*

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following donations were presented :—

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. 1838. 1er Semestre. No. 13.—*By the Academy.*

A Systematic and Stratigraphical Catalogue of the Fossil Fish in the Cabinets of Lord Cole and Sir Philip Grey Egerton. By Sir Philip Grey Egerton, Bart.—*By the Author.*

The following communications were read :—

1. Researches on Heat. Third Series. By Professor Forbes.

This paper is divided into three sections, each containing a distinct investigation.

The First Section is on the Variable Polarizability of different kinds of Heat. This fact, namely, that when polarization takes place by refraction through a bundle of parallel mica plates, some kinds of heat are less completely polarized than others at the same incidence, the author proposed to establish in the second series of his researches. His investigations, however, having been considered by some persons as open to objection, and directly contrary results having been obtained by M. Melloni in his repetition of these experiments, the author was induced to investigate the subject anew and with every precaution. He used rays of heat rendered parallel by a rock-salt lens, previous to falling on the mica plates, which were removed to a distance from the pile; but still the differences in the Parallel and Crossed positions of the mica bundles, when heat of various qualities was used, were as unequal as formerly; and having varied the experiment in different ways, the author concludes by adhering to his former conclusion, and gives the following table of the proportions of the heat penetrating the mica plates when parallel, which were stopped in their crossed position :—

Source of Heat.	Rays per cent. polarized.
Argand Lamp,	78
Locatelli Lamp,	75 to 77
Incandescent Platinum (usually),	74 to 76
Incandescent Platinum, with glass .06 inch thick interposed, 6 to 7 per cent. more, or	80 to 82
Alcohol flame,	78
Brass heated to about 700°,	66.6
Do. with a plate of Mica .016 inch thick interposed,	80
Mercury in a Crucible at 450°,	48
Boiling Water,	44

The apparently uniform polarizability of all kinds of heat, as observed by M. Melloni, the author shews must necessarily arise from the use of mica bundles, such as he used, consisting of a great number of distinct plates of mica superimposed. Such a thickness of mica modifies heat from dark sources in such a way as to give the portion which it transmits the same character as to polarizability as luminous heat. The plates used by the author, and split by the action of a hot fire, as explained in a former paper, contain so many surfaces within a very small thickness, that the polarized heat is comparatively unaltered in its character. The author shews that the piles used by him transmit heat from a lamp sifted by glass, and from brass at 700° in nearly equal proportions, whilst mica .016 inch thick transmits five times less of the latter than the former.

The SECOND Section relates to the Depolarization of Heat. Pursuing the methods given in the first series, the author ascertained the proportion of heat depolarized by five different thicknesses of mica. From the numerical results thus obtained, he deduces the value of the expression in Fresnel's formula of depolarization, for $\frac{\text{retardation}}{\text{length of wave}}$, either of which quantities being assumed, the other becomes known. If the numerator (the difference of paths described within the depolarizing mica plate by the ordinary and extraordinary ray) be assumed to be the same as in light, the length of a wave would come out 3 times as long as for red light, and 4½ times as long as a violet wave. Since, however, this result seems not easily reconcilable with the slight difference of the mean refractive index for heat and light (which is afterwards obtained), the author rather inclines to the supposition, that the energy of double refraction is smaller for heat than for light, or that a greater thickness of the medium is required to produce a given retardation.

Almost exactly similar numerical results were obtained for heat from an argand lamp, from incandescent platinum, and from brass at 700°.

The Third and longest Section of the paper, relates to the Index of Refraction for Heat of different kinds compared to Light. The method of observation adopted by the author, resembles in principle Dr Wollaston's method of determining Indices of Refraction for Light by the Critical Angle of Total Reflection. (Phil. Trans. 1802.) The practical part consists in determining the critical angle of transition from partial to total reflection within a rock-salt prism, having two angles of 40° and one of 100°. The sentient surface of the thermal pile is so placed with regard to the prism, that it continually receives rays coming from the source of heat after undergoing two refractions and one reflection, whatever be the angle of incidence. This is accomplished by mounting the whole on a jointed rhomboidal frame, the surface at which total reflection takes place being maintained by a mechanical contrivance constantly perpendicular to the diagonal of the rhomboid, the incident and reflected rays being always parallel to its side, to which the source of heat and thermal pile are fixed. In this way (a number of precautions being taken, and modes of reduction adopted which cannot here be explained) the following indices of refraction were approximately determined, for the *mean* quality of the heat most abundantly contained in the rays obtained from various sources :—

Heat from	Index of Refraction from Rock-Salt.
Locatelli Lamp,	1.571
Ditto, transmitted by Alum,	1.598
.... Glass,	1.587
.... Opaque Glass,	1.593
.... Opaque Mica,	1.583
Incandescent Platinum,	1.572
Ditto, transmitted by Glass,	1.588
.... Opaque Mica,	1.584
Brass about 700°,	1.568
Ditto, transmitted by Clear Mica,	1.577
Mercury at 450°,	1.572
Mean Luminous Rays,	1.902

The following general conclusions were deduced from the experiments of this section. (1.) That the *mean* quality, or that of the more abundant proportion of the heat from different sources, varies within narrow limits of refrangibility. (2.) That these limits are very narrow indeed where the *direct* heat of any source is employed.

(3.) That all interposed media (including those impermeable to light), so far as tried, *raise* the index of refraction. (4.) That all the refrangibilities are inferior to that of the mean luminous rays. (5.) That the limits of Dispersion are open to farther inquiry, but the dispersion in the case of the sources of low temperature appears to be smaller than in that from luminous sources.

2. Remarks on the Illustrations presented by the Surface of the Moon, respecting certain Geological Phenomena. In a Letter to Sir J. Robison, K. H, &c. from Professor Nichol, University of Glasgow.

Professor Nichol conceives that, as the upheaving cause is a general or cosmical phenomenon, no true or complete theory of it can be deduced from a review of its merely terrestrial actions; and in the notice read to the Society, he called the attention of geologists to a few general but important inferences, from the peculiar form of the elevations in the moon.

The author introduced his observations, by adverting to the following facts, as now ascertained and generally known concerning these elevations.

1. There are ranges of mountains in the moon, but they are comparatively few. Some of them, especially the Apennines, with their attached extensive highlands, bear a close resemblance to many terrestrial ranges.

2. The chief form of elevation is the *circular*. The moon's surface is absolutely studded with crater-forms,—objects recently examined with much care, and represented in an admirable map, by Beer and Mädler of Berlin. Their diameters vary from fifty or sixty miles to the *minimum visibile*, and they greatly increase in number as their magnitude diminishes. They are all marked by this singular feature—*their interior is deeper than the general lunar surface*, as if the elevation had been occasioned by a mass of the moon being blown out from a single point of disturbance. It is to be noticed, likewise, that the *external* effect of this disturbance in no case extends very far. In some instances the crater-ridge rises at once out of the flat body of the moon, without appearing to affect it almost at all; but even where this surface has been raised and disturbed, as in the case of the crater *Copernicus*, the sphere of the action seems exceedingly confined, when compared with the transverse extent through which a disturbance is felt on the earth. There is nothing on the earth to which these formations can be

likened, except "*craters of elevation.*" The Cantal and the Montagnes d'Oisans, however, appear to be the ruin or debris of very similar objects.

3. For the most part, the *disposition* of these craters is irregular and capricious; but, in a number of instances, sufficiently considerable to indicate the operation of *law*, we find rows of small craters, close to each other, arranged almost in a straight line. This arrangement is perhaps a clue to two phenomena. *First*, Were the craters a little closer, a longitudinal portion of the moon's surface would be blown out, and a *furrow* would result, exactly like those curious furrows or ditches, which have often puzzled moon-explorers. *Secondly*, Had the seat of the disturbance been somewhat deeper, or the disturbing force somewhat weaker, a mere rectilinear elevation would have ensued,—*a serrated chain of mountains.*

Generalizing on these phenomena, Professor Nichol suggests that the following conclusions may be safely hazarded.

I. The forms of the moon give decided countenance to the theory of elevation craters, developed by Von Buch and De Beaumont, as at least one *modus operandi* of the upheaving cause. It even appears to be the leading or fundamental one.

II. The doctrine of the central heat derives no support from these phenomena. The irregular distribution of the craters is not favourable to the idea of any central or general action; and the limited sphere of the disturbance connected with them, demonstrates that their source is superficial. They rather appear as the *clearing out* of local deflagrating forces, whose seat is between the two outermost shells of the moon's body.

III. The hypothesis of secular refrigeration is, according to the author, discredited by the survey of lunar phenomena. This hypothesis was formed upon the idea, that elevations are generally linear, and along great circles of the sphere; whereas in the moon, linear elevations are the *exception.*

IV. The moon enables us to eliminate a number of non-essential circumstances, from the ultimate problem of the upheaving cause. For instance, the theory lately promulged by Sir John Herschel relative to the dependence of convulsion and elevation upon abrasion and stratification, according to the author, will not stand good. Considering that the temperature of the earth increases with its depth, in so far as we have yet descended, it is undoubted that abrasion and stratification will cause changes of temperature among the inferior rocks, and therefore expansions, fractures, and extensive though slow movements; and to this extent the theory indicates a *vera causa*, the origin, probably, of certain changes upon the earth; but it is not the ultimate and complete theory of the elevating cause. *The moon contains no abrading or stratifying agents*, nor is it probable that any substance akin to water has yet been developed there.

Professor Nichol means to examine with great care, and sketch upon a large scale, some of the more characteristic individual formations in the moon, with a view to their geological relations. In so far as general selenography is concerned, the labours of Beer and Mädler leave nothing to be desired.

Monday, 7th May.

Dr HOPE, V. P. in the Chair.

The following was elected as an Ordinary Fellow:—

Thomas Mansfield, Esq.

The following Donations were presented.

A Catalogue of Circumpolar Stars, deduced from the Observations of Stephen Groombridge, Esq., F. R. S. Edited by George Biddell Airy, A. M., Astronomer-Royal.—*By the Lords Commissioners of the Admiralty.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences 1838. 1er Semestre. Nos. 14, 15.—*By the Academy.*

Memorias da Academia R. das Sciencias de Lisboa. Vol. xi. pt. 2, and vol. xii. pt. 1.—*By the Academy.*

Proceedings of the Royal Irish Academy for the year 1836–37. Part 1.

Transactions of the Royal Irish Academy. Vol. xvii., parts 2 and 3.—*By the Academy.*

Journal of the Asiatic Society of Bengal for September and October 1837.—*By the Society.*

Inquisitionum in Officio Rotulorum Cancellariæ Hiberniæ Asservatarum, Repertorium. Vols. i. ii.

Rotulorum Patentium et Clausorum Cancellariæ Hiberniæ Calendarium. Vol. i. part 1. Hen. II.—Hen. VII.

Rotuli Chartarum in Turri Londinensi Asservati. Accurante Thoma Duffus Hardy, S. S. A. è Soc. Int. Templ. Lond. Vol. i. part 1. Ab anno MCXCIX. ad annum MCCXVI.

Registrum vulgariter nuncupatum, "The Record of Caernarvon;" è Codice m.s^{to}. Harleiano 696 Descriptum.

General Report to the King in Council from the Honourable Board of Commissioners on the Public Records, appointed by His Majesty King William IV., by a Commission dated the 12th March in the first year of his reign; with an Appendix and Index.—*By the Commissioners on the Public Records of the Kingdom.*

The following communications were read:

[illegible]

1. On the Fourth and Sixth Nerves of the Brain, being the concluding paper *on the distinction observed in the Nerves of the Encephalon and Spinal Marrow.* By Sir C. Bell.

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As no fewer than six of the nine nerves which arise from the brain are connected with the organ of vision, he finds it necessary to announce, not only the distinct sensibilities possessed by the organ of vision, but the motions to which it is subjected. Having shewn the connection of the voluntary motions of the eye-ball with the sensation on the retina, and the motions involuntary and for the protection of an organ so delicate and so exposed, he proceeds to shew the necessity of combinations among the muscles of the eye. As there are no direct communications between the muscles, necessarily united in action, he shews the necessity of distinct nerves, and also the necessity of their relations being established at their roots, and hence deduces the reason of the fourth and sixth nerves deviating from the others in their place and mode of origin.

The paper concludes with a recapitulation, accounting for the fact that no one nerve of the head is like another, and why they are all different from the spinal nerves.

First, As to the irregularity of the NERVES OF THE SENSES, they all tend inwards to that column which has received the nerves of sense, and must take a course round the column which extends from the spinal marrow to the brain, and which is given to the voluntary motions. Hence the form of the *tractus opticus*—the peculiar roots of the olfactory nerve, and course of the roots of the auditory nerve.

Second, The second, third, fourth, part of the fifth, the sixth, in addition to the nerves of the eyelids, crowding into the orbit; each for a particular purpose, or with distinct endowment, causes much of the apparent irregularity in the nerves of the base of the brain.

Third, The fifth nerve being like a spinal or double nerve, shooting up into the base of the brain, and in the centre of nerves of a peculiar function, gives additional intricacy.

Fourth, The Nerves of Respiration, standing distinct in origin and function from all the others, and yet necessarily bestowing influence on some of these, complete the apparent irregularity of the nerves of the base of the brain.

In short the double origin and double function of the nerves of the spine, is the reason of their uniformity and simplicity, as they are all alike. The nerves of the brain differ from each other, and from the nerves of the spine, inasmuch as each has its peculiar origin and distinct function; they, therefore, vary in course and distribution, and hence the apparent intricacy.

2. On the Superficial Deposits of Gravel, Clay, Sand, &c., which cover the Rock Formations of the Lothians, and south coast of Fife. By David Milne, Esq.

The author enumerated seven different deposits, overlying the rocks of the district, and subjacent to the existing soil which supports vegetation. These he described in the following order, beginning with the lowest.

(1.) *Sand and fine gravel*, which in some places form beds twelve feet thick.

(2.) *Boulder-clay*—being a stiff black or dark brown clay, characterised by enormous boulders imbedded in it, and which is occasionally forty feet thick.

(3.) *Gravel or stoney clay*—of a light brown colour, full of gravel and angular fragments of rock, not exceeding thirty feet in thickness.

(4.) *Beds of fine clay*, out of which the greater part of the bricks and tiles manufactured in the district are made. At Portobello this clay is 100 feet thick.

(5.) *Banks of sand*—pretty free from gravel, and containing occasionally fragments of shale and coal, sometimes thirty-five feet thick, and existing at a level 200 feet above the sea.

(6.) *Shelly and sandy deposit*, intervening between the shores of the Firth of Forth and an ancient sea-cliff that runs nearly parallel to the shore, but not rising higher than forty feet above high-water mark.

(7.) *Upper covering of gravel and boulders*—nowhere exceeding ten feet in thickness, and rising to a height of 900 feet above the sea.

(8.) *Existing soil.*

The particular characters of each of these deposits were fully described, and the organic remains found in each taken notice of; the places where they are visible were mentioned, as also the highest level above the sea where the author had observed them. These matters of mere fact occupied the first portion of the paper.

In the last part of the paper were stated the inferences of the author regarding the condition of things on the surface of the globe (in this particular district) when the several deposits above enumerated took place.

(1.) The beds of sand and fine gravel indicate the prevalence over the district of a deep sea, by the waters of which the shales and sandstones and limestones of the coal-measures had been worn down to a nearly uniform surface. Reference was made to a paper on the coal-field of the Lothians, read at a previous meeting, where it was stated, that the strata cut across by the Sheriff-hall slip had sunk down ninety fathoms on the north side, in consequence of which there had been a precipice of more than 500 feet on the south side, all which had been worn down and washed away. As the whole coal-field was riddled with similar slips, it was evident that abundance of materials would in this way be provided for the formation of banks of sand and gravel.

(2.) The next period was characterized by violent and extensive movement in the waters which covered the district. The boulder-clay had, with its imbedded boulders, been evidently brought from the west. These boulders were most numerous to the east of Arthur Seat, where they had been protected from the rush of waters. The ruts and scratches on the boulders, and in the subjacent rocks, were, both in Mid-Lothian and in Fife, about W. by S. in direction by compass; and, moreover, many of the boulders imbedded in the clay belonged to rocks which do not occur nearer than Callendar. A deep excavation or scooping out in the rocks was noticed as occurring between Niddry and Stoneybank, which excavation is filled with large boulders. The waters which transported this enormous mass of debris must have been *at least* 600 feet above the level of the present sea.

(3.) The stoney or gravel-clay, lying immediately over the boulder-clay, indicated less violence and less extent of agitation and movement in the waters.

(4.) The deposits of clay prove that general tranquillity or calmness succeeded the above periods. From the discovery of terrestrial remains, both animal and vegetable, in this deposit, it is obvious that land had not been far distant; and, accordingly, the nature of the shells found in it, partakes somewhat of an estuary character.

(5.) The banks of sand which lie over the clay, shew that the supply of albuminous sediment which, during the former period, was poured into the ancient sea, at or near this district, had altogether ceased. The fact of these sand-banks running nearly east and west, in all parts of the district, coupled with the discovery in them of stones which must have come from the west, prove the general direction of the current to have been from the west. The sea at this period must have been still *at least* 300 feet above the present level of it.

(6.) The next epoch is characterized by a very remarkable change of the relative levels of sea and land. The old bank which runs nearly parallel with the shores of the Firth of Forth, has been formed sometimes out of the fine brick-clay, and sometimes out of the sand last described. The base of this bank on the east shore of Haddingtonshire is about thirty feet above high-water mark; whilst towards the west it gradually increases to forty feet, which is its height in Linlithgowshire. A bed of shells and sand generally intervenes between said old bank and the present shore.

(7.) The next period is characterized by a still more remarkable change in the relative levels of sea and land. The upper covering of gravel and boulders has been spread over and above all the deposits previously described, and it reaches even to the height of 900 feet above the sea. This would indicate a sinking of the land or elevation of the waters, to that extent, and a subsequent reversal of the operation, whereby at length the land again emerged from the waters, and attained the elevation which it now possesses. These boulders are not very much rounded in shape, and do not seem to have been transported from very distant parts. They are frequently angular in shape.

3. Investigation of a New Series for the Rectification of the Circle. By J. Thomson, LL.D. Glasgow.

4. On the Real Nature of Symbolical Algebra. By D. F. Gregory, B. A.

The object of this paper is to determine in what consists the difference between general Symbolical Algebra and the sciences subordinate to it, particularly Arithmetical Algebra. The view which the author takes is, that Symbolical Algebra takes cognizance only of the laws by which the symbols are combined, without considering the nature of the operations represented. The greater part of the paper is occupied in applying this definition, by shewing what are the laws to which are subject the various symbols of operations we are in the habit of using; and one or two examples are given of the advantages derivable from this way of considering the subject—particularly with respect to the connection between the arithmetical and geometrical meanings of + and —. The chief application of the theory may be said to be the elucidation of the causes of analogies between operations by no means similar in their nature.

2. On a New Method in the Conic Sections. By J. Scott Russell, Esq.

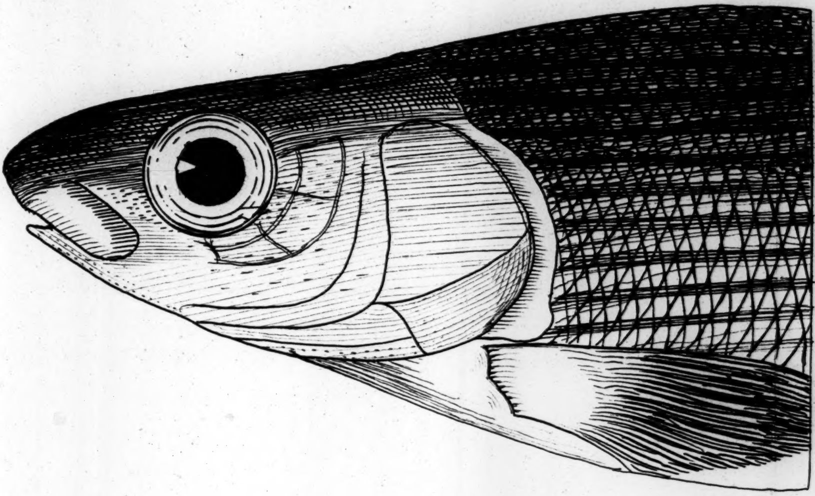
In this paper the author institutes an examination of the various methods of conceiving and constructing the conic sections, the different standards of comparison to which they have been referred, and the means by which their properties have been developed and expressed in the ancient and modern schools of mathematics. He finds that the constitution of the curves *in plano* by means of their remarkable properties, and the demonstration of their other properties from the constitution so obtained; have been noticed by Eutocius in the 6th century, and by him referred to Apollonius, although the formal adoption of the plane method is generally referred to a recent date.

The author agrees with modern writers in considering the plane method in the conic sections as more philosophical, as well as more useful, than the solid method; but he differs from them in the methods of constituting these curves, without reference to what he considers their proper origin and standards of reference. Apollonius employed the straight line and circle to constitute his cone; or, in other words, he derived the conic sections from the straight line and the circle, using the cone as the *mechanism of derivation*. Mr Russell has succeeded in deriving the conic sections from the straight line and circle directly, without the intervention of the cone. He thus removes the conic sections altogether from the geometry of solids into the geometry of planes, according to the modern method, without separating them from the family of the circle to which they properly belong.

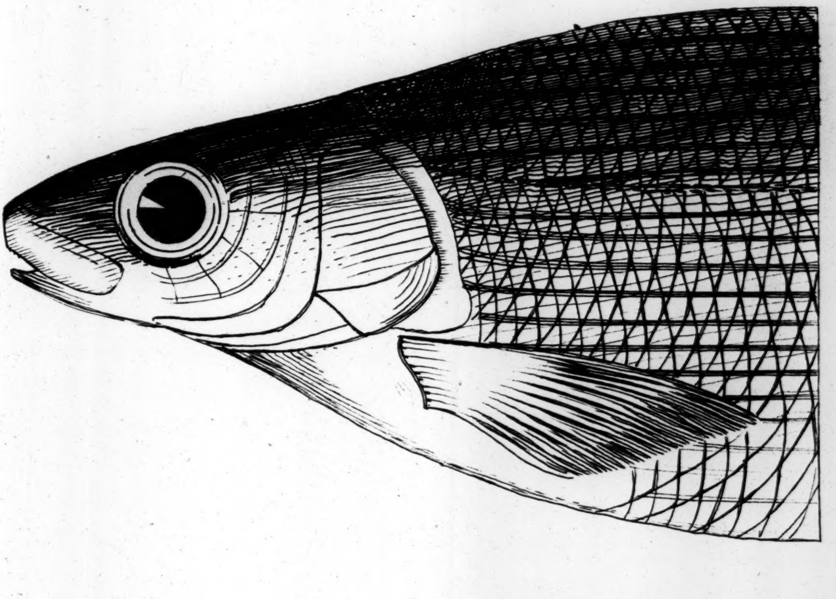
The definition from which he sets out is this: If between a given circle and its tangent straight line there be traced a curve whose distance from the circle shall bear a constant proportion to its distance from the straight line, that curve is a conic section, and according as the given ratio is one of equality, deficiency, or excess, the cone becomes a parabola, ellipse, or hyperbola.

The author shews with how much facility the other properties of the curve follow from this constitution: he gives examples of some of these, shews a new and remarkable property of the tangents of the conic sections, and proves that they may be readily identified with the sections of the cone from the constructive property alone, without the intervention of any derived property.

[*The Meetings were adjourned till the first Monday in November.*]



Coregonus Lacepedei Natural size



Coregonus microcephalus Natural size

Coregoni of Loch-Lomond.

R. Parnell